

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application.

LISTING OF CLAIMS

1. (Currently Amended) A centrifugal blood pump apparatus comprising:
 - a housing having a fluid inlet port and a fluid outlet port;
 - a centrifugal pump section including an impeller having a first magnetic material therein and ~~rotating~~ rotatable inside said housing to feed a fluid by a centrifugal force generated during a rotation thereof;
 - an impeller rotational torque generation section for attracting and rotating said impeller;
 - and a hydrodynamic pressure groove formed at a portion of an inner surface of said housing at a ~~rotor-disposed~~ an impeller rotational torque generation section side or at a portion of a surface of said impeller at said ~~rotor-disposed~~ impeller rotational torque generation section side,
 - said impeller ~~rotating~~ being rotatable without contacting said housing owing to an action of said hydrodynamic groove,
 - ~~said centrifugal blood pump apparatus further comprising:~~
 - an electromagnet for attracting said first magnetic material of said impeller or a second magnetic material provided on said impeller separately from said first magnetic material in a direction opposite to a direction in which said impeller rotational torque generation section attracts said first magnetic material and helping said impeller levitate; and

a control mechanism for controlling said impeller rotational torque generating section and said electromagnet, said control mechanism starting rotation of said impeller rotational torque generating section with said electromagnet attracting said impeller thereto at a force not less than a predetermined value.

2. (Currently Amended) A centrifugal blood pump apparatus according to claim 1, wherein said impeller rotational torque generation section has a rotor having a magnet for attracting said first magnetic material of said impeller and a motor for rotating said rotor; and said hydrodynamic pressure groove formed at the portion of ~~an~~ the inner surface of said housing at a rotor-disposed side or the portion of ~~a~~ the surface of said impeller at said rotor-disposed side, and said electromagnet for attracting said first magnetic material or ~~a~~ the second magnetic material in a direction opposite to the direction in which said magnet of said rotor attracts said first magnetic material ~~and helping to help~~ said impeller levitate.

3. (Currently Amended) A centrifugal blood pump apparatus according to claim 2, wherein said first magnetic material of said impeller and said magnet of said rotor for attracting said first magnetic material ~~consist of~~ comprise a plurality of permanent magnets respectively; and said permanent magnets of said impeller ~~and said permanent magnets of said rotor are arranged on a circumference respectively in such a way that~~ in first and second different circumferential arrangements, and said permanent magnets of said rotor are arranged in first and second different circumferential arrangements, said permanent magnets forming the first circumferential arrangement of said permanent magnets of said impeller and the first

~~circumferential arrangement of said permanent magnets of said rotor have the same polarity, respectively facing each other with opposite polarities, said permanent magnets forming the second circumferential arrangement of said permanent magnets of said impeller and the second circumferential arrangement of said permanent magnets of said rotor facing each other with opposite polarities[(:)] and said permanent magnets of said impeller and said permanent magnets of said rotor are arranged on two different circumferences facing each other in such a way that a polarity of said permanent magnets of said impeller arranged on one of said two circumferences and a polarity of said permanent magnets of said rotor arranged on the other of said two circumferences are opposite to each other.~~

4. (Currently Amended) A centrifugal blood pump apparatus according to claim 1, wherein said impeller rotational torque generation section has a plurality of stator coils, disposed circumferentially to rotate said impeller, for attracting said first magnetic material of said impeller of said centrifugal blood pump section; and said hydrodynamic pressure groove being formed at the portion of ~~an~~ the inner surface of said housing at a stator coil-disposed side or at the portion of a the surface of said impeller at said stator coil-disposed side thereof, and said electromagnet ~~for~~ attracting said first magnetic material or a the second magnetic material in a direction opposite to the direction in which said stator coils attract said first magnetic material and helping said impeller levitate.

5. (Currently Amended) A centrifugal blood pump apparatus according to claim 1, ~~further comprising a wherein the~~ control mechanism[(:)] ~~for controlling said~~

~~impeller rotational torque generation section and said electromagnet, having a function of changing~~ changes a degree of an impeller-attracting force of said electromagnet according to a rotation speed generated by said impeller rotational torque generation section.

6. (Currently Amended) A centrifugal blood pump apparatus according to claim 5, wherein said control mechanism ~~has a function of keeping~~ maintains a constant distance between said impeller and said housing ~~constant~~ by changing a the degree of an the impeller-attracting force of said electromagnet according to the a rotation speed generated by said impeller rotational torque generation section.

7. (Canceled)

8. (Currently Amended) A centrifugal blood pump apparatus according to claim 1, ~~further comprising a wherein the~~ control mechanism~~[[,]] for controlling said motor and said electromagnet, having a rotation start state control function of starting a rotation of said impeller rotational torque generation section with said electromagnet attracting said impeller thereto at a force not less than a predetermined value; and a control function of reducing~~ reduces an attractive force of said electromagnet to a value less than said predetermined value after said impeller rotational torque generation section starts to rotate.

9. (Currently Amended) A centrifugal blood pump apparatus according to claim 5, wherein said control mechanism ~~has a function of monitoring~~ monitors

electric current of said impeller rotational torque generation section and controls said electromagnet by using an electric current value detected by said ~~function of monitoring said electric current of said impeller rotational torque generation section~~ control mechanism.

10. (Original) A centrifugal blood pump apparatus according to claim 1, wherein a corner of said hydrodynamic pressure groove is chamfered to allow said corner to have a radius of rounding at not less than 0.05 mm.

11. (Original) A centrifugal blood pump apparatus according to claim 1, wherein said centrifugal blood pump apparatus has a second hydrodynamic pressure groove formed at a portion of an inner surface of said housing at a electromagnet-disposed side or at a portion of a surface of said impeller at said electromagnet-disposed side.

12. (Original) A centrifugal blood pump apparatus according to claim 11, wherein a corner of said second hydrodynamic pressure groove is chamfered to allow said corner to have a radius of rounding at not less than 0.05 mm.